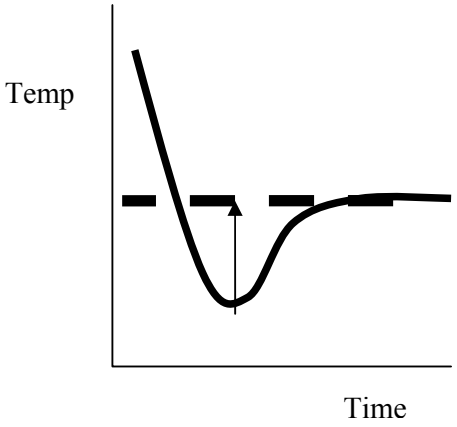
SALOL Supercooling

Background:

In Year 10 science we measured the melting temperature of SALOL and were all surprised to find that it stayed liquid even when cooled far below its melting point (supercooling). The cooling curve looked like

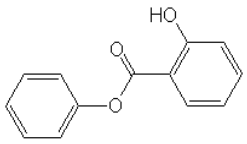
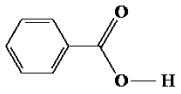
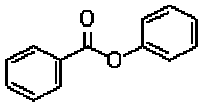


The headed arrow shows the degree of supercooling which is the difference between minimum and freezing temperatures.

In this investigation I will try to see if other similar compounds supercool and then which chemical features of SALOL are responsible for its supercooling.

Aim: To investigate which features of the chemical structure of SALOL affects its property of having a large degree of supercooling.

Table of the compounds used in the investigation

Name	Molecular Formula	Melting Point(˚C)	Chemical Structure
SALOL (Phenyl Salicylate)	$C_{13}H_{10}O_3$	43	
Benzoic Acid	$C_7H_6O_2$	122.5	
Phenyl Benzoate	$C_{13}H_{10}O_2$	71	
Phenol	C_6H_5OH	40.89	

Source: Handbook of Chemistry and Physics 85th Edition-David R.Lide

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These compounds have been chosen because:

-If Phenyl Benzoate supercools, then it may be that the 2 benzene rings which are separated by the rotatable ester group in between them, affect supercooling in SALOL.

-If Benzoic Acid supercools, then could be the single benzene ring, the oxygen atom and the OH molecule which are both bonded to the benzene ring in SALOL, that affects supercooling.

-If Phenol supercools then the single benzene ring and the OH group which is bonded to the benzene ring in Salol, affects supercooling

Variables:
Dependent Variable: Minimum temperature reached during freezing process.
Independent Variable: The identity of compound
Controlled Variable: The mass of the compounds, container used, maximum temperature above melting point that initially heated to, the fact that no stirring will take place.

Apparatus:

-1x Bunsen Burner
-1x Tripod stand
-1x Gauze Mat
-1x beaker (1000ml)
-4x Thermometers
-1x Electronic balance
-1x Spatula
-4x test tubes (20 ml)
-1x Rack
-1x Stopwatch
-1x Clamp Stand
- corn oil
- water
- minimum of 3g each of Salol, Phenyl Benzoate, Benzoic Acid and Phenol.

Procedure:

1. Label the 4 test tubes so that each test tube is specified for 1 compound.
2. Measure the mass of each of the 4 test tubes and record it.
3. Add 3g of each chemical into its specified test tube.
4. Fill a 1 litre beaker up to the middle with water in order to create a water bath. Place it on the tripod on top of the gauze mat and start heating it.
5. Place a thermometer in the test tubes which contain the **phenol and salol** (similar melting points so can be done together and place the test tubes into the water bath, so that the temperature can be controlled.
6. Wait until the temperature in both of the test tubes reaches 60˚C
7. Remove the test tubes from the water and place them on the rack.

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8. Measure the temperature of both the phenol and salol every 2 minutes for 30 minutes, and record it on a table. Make special note of minimum temperature reached.
9. Repeat steps 5 – 8 to get second reading using same samples.
10. Place the test tube containing the Phenyl Benzoate on top of the Bunsen burner with a clamp stand and start heating it up to 75˚C
11. Remove the Bunsen burner and measure the temperature of the Phenyl Benzoate every 2 minutes for 30 minutes. Make special note of minimum temperature reached.
12. Repeat steps 10 - 11
13. Repeat the procedure used for heating the Phenyl Benzoate, for the Benzoic acid but instead of heating it to 75˚C, heat it up to 130˚C by using an oil bath not a water bath.
14. Once the 130˚C have been reached, remove the Bunsen burner and start recording the temperature of the Benzoic acid every 2 minutes for 30 minutes. Make special note of minimum temperature reached.
15. Repeat steps 13 - 14.

Warning: Risk of injury because of high temperature, eye protection must be worn at all times.

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